

TESTIMONY OF DR. JOSEPH S. KRAEMER

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BEFORE THE SENATE COMMERCE COMMITTEE

ON THE SUBJECT OF THE

TRANSITION TO DIGITAL TELEVISION (DTV)

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SUMMARY OF TESTIMONY: DIGITAL TELEVISION TRANSITION

- I. A range of outcomes is possible. In this testimony and in an attachment hereto, I have outlined three scenarios:**

<u>Scenario</u>	<u>Analog Turn-off</u>	<u>Government Role</u>
Rapid	2010	Intervenes Early
Moderate	2015	Largely Passive
Slow	2020	Uninvolved

Actions taken or not taken by Government in 2001 will affect decisively which scenario is realized.

- II. It is in the interest of most stakeholders to accelerate the DTV transition (i.e., achieve the rapid scenario). Benefits include:**

- 1. Return analog spectrum leading to auction revenues for the Government and the build out of wireless high speed data networks;**
- 2. Shift to a self-sustaining demand pull market;**
- 3. Trigger waves of capital investment by manufacturers, programmers, broadcasters, and networks which will have multiplier effects on employment and income at each stage in the industry's supply chain;**
- 4. Improve the quality of the TV picture and audio experience for consumers; and**
- 5. Decrease the length of time broadcasters operate expensive dual analog and digital transmission systems.**

- III. Government intervention is both possible and necessary to accelerate the transition. The critical factor is to expose consumers to digital TV.**

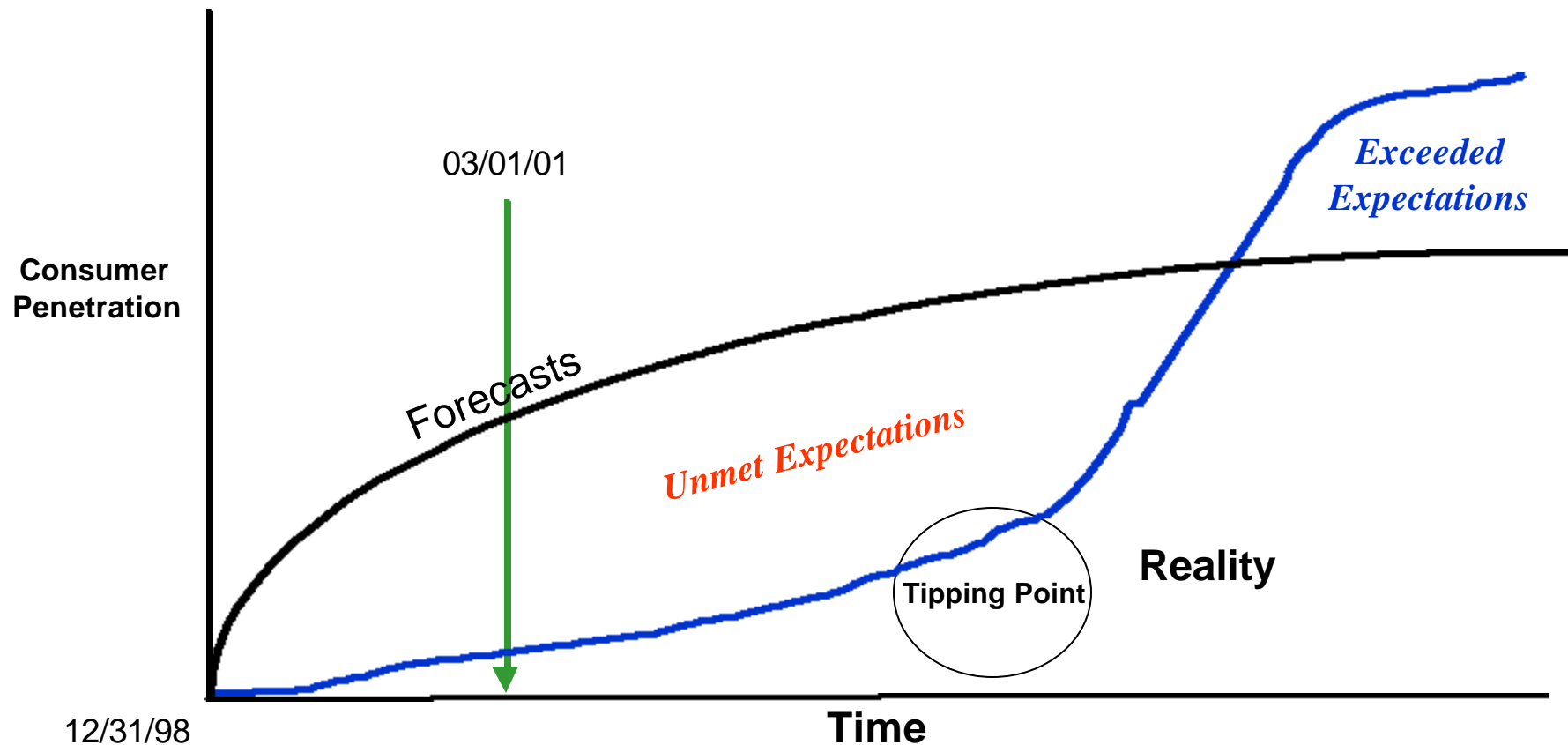
Once exposed, consumer demand will “tip” the market, creating a self-sustaining mass market.

It is time to consider whether Government can intervene positively and then step aside and let market forces work. Two points of leverage exist:

- 1. *All channel receivers:* logic exists to enable sets, sold after a date certain to receive over-the-air digital broadcasts; and**
- 2. *Digital must-carry:* with the primary set in 65% of U.S. households hooked up to cable, a time-limited (three-year?) requirement to carry both analog and digital over-the-air broadcasts allows consumers to experience DTV.**

The lead on intervene probably belongs to the FCC, but Congress has a role as well.

The Critical Issue is the Point When the Market “Tips” and Becomes Self-sustaining



“... We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.” Bill Gates

I. DIGITAL TELEVISION (DTV) TRANSITION SCENARIOS

A. DTV Scenarios

DTV requires a very long-term perspective. The transition to digital *could* take all or most of the next two decades and will affect literally all 100 million U.S. households.

With respect to DTV, the decisions made in the 2001-02 timeframe have a “long fuse,” and a “big bang,” three to five years later, with a material impact on shareholders, employees, partners, suppliers, customers, and management.¹ Many participants in the DTV transition are playing a game of “bet the company.” At a minimum, most stakeholders are placing a significant portion of future earnings at risk.

Scenarios assist decisionmaking under conditions of uncertainty. Scenarios are not intended to predict the future. Rather, they can be used to facilitate an understanding of a reasonable range of options and the consequences of those options. The development of the scenarios used in this testimony are based on the results of interviews conducted in late 2000, as well as a general understanding of industry developments.

In order to be successful, scenarios must be reality based, taking into account external conditions that are “givens” and cannot be changed in the short or intermediate future. For DTV scenarios, it is important to remember that:

1. **No dominant player exists.**

The television supply chain is fragmented at each level from manufacturing of equipment through production and distribution of content. No equivalent of Microsoft in the PC operating systems business or Intel in the chip business – or even a duopoly like Coke and Pepsi – exists. Therefore, no single company by itself – not Sony, not General Electric, not Disney/ABC – can determine the outcome. Thus, each stakeholder must formulate their own unique strategies because there is no leader to fall in line behind.

2. **Government is relevant and can affect the speed and course of DTV rollout.**

DTV has a political dimension. The FCC, Congress, the courts, and multiple presidents yet-to-be-elected will influence the pace of DTV rollout.

It must be remembered that achievement of the legislated objective of 85% of households with digital capability (defined as the primary viewing set) could be attained by some mix

¹ “Long fuse, big bang” decisions involve judgements made, instructions given, and actions taken, the success of which cannot be measured for years but the outcome of which will determine the survival of the organization. One of the ironies of “long fuse, big bang” decisions is that the management that makes these decisions has often moved on and a new generation of managers (and shareholders) have to live with the outcome.

of: (1) digital-to-analog cable set top boxes in combination with digital set tops for digital sets; (2) satellite digital-to-analog conversion; and (3) free-to-air broadcasts to digital sets with or without a roof antenna. Also, the 85% is of primary sets only; it does not address the embedded base of 150+ million secondary sets (that are in addition to the 100 million primary sets in the U.S.).

For DTV three general scenarios make sense:

1. **Rapid Transition:**

This scenario incorporates a series of assumptions so that the transition resembles the rapid take up of black and white TV after World War II or the rise in usage of the World Wide Web (i.e., fast, deep, and successful).

Rapid Transition: 85% in 2006-08; Analog turn-off 2010-11

- Stakeholders cut deal to move DTV forward.
- Consumer exposed to DTV and demand “tips” 2005-06 so that mass market emerges.
- Channels 60-69 and 52-59 are auctioned almost on schedule.
- Congress and the FCC intervene on matters such as all channel receivers and must-carry.

2. **Moderate Transition:**

The core theme is that the interlocking series of events necessary for DTV go neither terribly right nor terribly wrong.

Moderate Transition: 85% in 2010-12; Analog turn-off 2014-15

- No stakeholder deal is negotiated.
- Auctions are delayed and not meet expectations; spectrum use taxes are probable.
- Broadcasters operate expensive parallel system both analog & digital.
- Government remains passive and hesitant to intervene.

3. **Slow Transition:**

Under this scenario, many factors combine to frustrate and slow the DTV rollout. This could occur due to some combination of technology, regulatory, and/or market factors. (Exogenous events, such as a stock market collapse combined with rising unemployment and declining consumer confidence could also play a causal role.)

Slow Transition: 85% after 2014; Analog turn-off 2020

- Free-to-air broadcast TV becomes increasingly less relevant.
- Networks bypass affiliates and go to cable head ends.
- Government takes no action; FCC adopts “let the market decide” attitude.

DTV scenarios do not predict the future. However, they serve to: (1) sensitize stakeholders (including Government officials) to the implications of actions taken or not taken; and (2) emphasize the extent to which stakeholders must cooperate because no single company can control the outcome.

B. Diverse Points-of-View but Some Consensus on the DTV Transition

As part of an analysis I conducted late last year, broadcasters, manufacturers, network representatives, public officials and industry observers provided facts, opinions, official on-the-record positions, and unofficial not-for-attribution perspectives. Summaries of relevant, key themes that emerged are presented below.

1. Resolution of certain issues is required to accelerate the rollout of DTV.

The two issues mentioned most often as the most critical to broadcast DTV rollout were: (a) cable must carry; and (b) the availability of high definition and enhanced programming. **The logic of the respondents was that, if consumers could see DTV, then this would create demand pull and initiate a market-led transition to DTV.** Other factors such as content availability, copy protection, receiver prices, and all-channel tuner requirements must also come into line, or rollout will be delayed.

2. The core drivers are primarily business and public policy, not technical.

Almost all DTV technical issues have been resolved. Therefore, the issues remaining tend to be: (a) economic - - who spends how much and for what return; and/or (b) public policy - - should and how can government influence the transition to DTV?

3. The free-to-air television business will change significantly over the next five years.

Over the longer term, 90 percent of primary sets will be wired (either cable or satellite). Therefore, the long-term U.S. free-to-air market will consist primarily of secondary sets (e.g., smaller, largely portable, potentially pedestrian or better speeds), as well as computers (fixed or portable) as receivers.

4. **No single stakeholder controls the rollout of DTV.**

A multitude of DTV stakeholders (e.g., consumer electronics firms, networks, local broadcasters, program producers, cable, the FCC) exist with their own business or public policy interests. The potential exists for paralysis through mutually neutralizing business and public policy actions. On the other hand, most of the stakeholders have a shared economic interest in moving the transition forward.

5. **The digitalization of television in the U.S. will proceed; the issue is when, not if.**

The rollout of digital video could occur without much of a fixed free-to-air component. Digital production, DVD, satellite, digital cable, and streaming video are accelerating. Local broadcasters remain influential but by themselves are not decisive and could be isolated over the long term, especially if the broadcasters lack consensus on key DTV issues while other stakeholders press ahead with non-free-to-air digital television.

II. ACCELERATION OF THE DTV TRANSITION

A. The Benefits of Acceleration

When the history is written, there is a high probability that digital television (DTV) will be compared in some ways to the Internet – slow to take off, dominated in the early market phase by visionaries, benefiting from occasional government intervention, and global in impact but with distinctly American nuances. DTV will also be recognized in retrospect as one of those paradigm shifts that rearrange the economics of entire industries and create lists of winners and losers. Adaptability, flexibility, and a talent for strategic thinking (or lack thereof) constitute the three attributes that will separate the former from the latter.

A rapid transition to DTV will:

1. Facilitate the return of analog spectrum that in turn will be auctioned to network operators, which, in turn, will trigger a wave of investment in wireless broadband infrastructure, as well as contribute to maintaining budget surpluses;
2. Decrease the length of time broadcasters will need to operate dual analog-digital transmission systems; no trivial issue for stations in small markets and/or small stations in any market;
3. Shift the basis for the DTV market in the U.S. from the current ‘supply push’ model (i.e., government compels and broadcasters acquiesce) to a ‘demand pull’ model that sustains itself as a mass consumer market;
4. Materially improve the quality of the TV picture and audio experience for consumers;
5. Transform the entire TV supply chain from program planning and production through local transmission and reception;
6. Provide a potential new lease on life for the broadcasting industry that has been hemorrhaging viewers for ten years;
7. Trigger waves of investment spending by manufacturers, programmers, local broadcasters, and TV networks (including free-to-air, cable, and satellite), which will roll through the industry’s supply chain with a multiplier effect on employment and income.

If DTV had no other effects other than those above, it would be worth accelerating the transition. However, beyond its first tier effects, DTV will also act as a catalyst and

cause second tier effects that will be at least as significant, if not more so. In this second tier, the impacts of DTV will include:

1. Merge the TV and the PC so that the TV will have more in common with today's PCs than contemporary TVs;
2. Double the number of U.S. households with web access to collect information, send/receive e-mail, and shop at home thereby providing television a role in the networked economy of the 21st Century for TV networks; and
3. Intensify competition between and among video suppliers as networks are upgraded for digital transmission which will also provide bandwidth for Internet and other services.

Only a realistic assessment of the situation will achieve the potential of digital television in a reasonable period of time. That promise, by the way, can be more than even the optimists predict, but only if the digital transition is realistically planned and implemented by networks, manufacturers, government, broadcasters, and consumers themselves.

DTV is being rolled out currently without material consumer demand. Consumers that have invested in DTV sets tend to be either: (1) "technophiles" (responding to the potential of digital to merge the TV and the PC); or (2) "videophiles" (emphasizing the improved picture and audio capabilities of digital). These categories constitute the early market. The critical issue is when the DTV market "tips" and becomes a mass market. After the market tips, then it will become self-sustaining and based on 'demand pull' as did other markets such as color televisions, PCs, and cellular telephones.

In order to tip the market (i.e., accelerate the point in time when demand ramps up as a mass market), consumers must be exposed to DTV. Exposure will trigger demand for DTV receivers, digital programming, and ancillary services such as broadcasting to PCs (i.e., shift the market from its current 'supply push' context to a sustainable 'demand pull' basis).

B. The Role of Government

Government and the DTV transition have been inseparable from the beginning. If anything, there has probably been enough government intervention that DTV constitutes a rare example of industrial policy in the United States. The FCC guided the process that developed the DTV standards and then followed congressional guidance when awarding the spectrum necessary to transmit digital programming. At various points along the way (especially on the matter of spectrum award), Congress and the incumbent administration got involved and endorsed or modified private sector and/or FCC decisions as part of the public policy process in the late 1980s and 1990s. Now with the DTV transition slowed,

it is time to consider whether government can intervene one last time and, in a positive way to accelerate the transition.

I assume there is: (a) a public policy interest in facilitating a rapid transition to digital television to permit spectrum clearing; and (b) a belief on the part of regulators that market forces should be the ultimate driver of both the growth of digital television programming by broadcasters and acquisition of receivers by consumers. Therefore, if government is to accelerate the transition, then government must accelerate the rate at which consumers are exposed to DTV then step aside and let market forces work. There are two leverage points available.

Both the all-channel and digital must carry requirements would appear to be necessary to catalyze a market-driven DTV transition. If most TV sets cannot receive a digital signal, then there is very little incentive to generate digital programming. Such programming would be almost a novelty as was the case with color broadcasting when there were very few color television sets. However, since about 65% of total U.S. homes have cable service, *simply equipping the TV sets with the capability to receive digital signals may not provide the necessary incentive* unless the cable systems also must carry digital as well as analog off-the-air signals.²

Although the FCC is considering the all-channel and digital must carry issues in separate proceedings, the two requirements are interrelated. The first step would be to require that all new TV sets sold be capable of receiving a digital signal. Then, at a date on, or shortly after, the date when all new sets sold must be digital-capable, all cable TV systems would be required to carry both the digital and analog signals generated by the off-the-air stations. This requirement that cable TV systems carry both signals need only be in place for three years or so. After that, market forces would protect the public interest.

1. Requiring TV Sets to Be Able to Receive Both Analog and Digital Signals

The causal connection between needing a substantial installed base of TV sets capable of receiving a digital signal before the broadcasters will offer most, if not all, programming in a digital format seems obvious. The need to have such an installed base can be demonstrated by examining what happened to the viewership of UHF stations and the number of UHF stations after the all channel (VHF and UHF) tuner was required for all TV sets. The relative viewership of UHF stations increased among the off-the-air signals. Also, the ease of access of UHF channels and the increased viewership also led to more UHF stations being on-the-air. Finally, this also assisted the emergence of the new networks (e.g., FOX, WB, and UPN). Prior to the All Channel Tuner Act, the UHF stations had a relatively high failure rate and that entry by UHF stations had been very disappointing.

² For the households with the most sought after demographics by broadcasters and advertisers, cable penetration probably is higher than 65%.

Second, the experience with color television also can be helpful. Color television was never mandated, but color programming was very limited until the installed base of color television sets reached a critical mass. Similarly, one cannot expect a substantial increase in digital programming until there is a substantial installed base of TV sets that can receive digital signals. NBC was seen as taking a substantial risk when it took the lead in going to all-color prime-time broadcasting. At that time, of course, RCA/NBC was vertically integrated into TV set production. Today, even if a network were to make a DTV programming commitment (as CBS appears to be doing), the transition would be stillborn if set manufacturers did not provide follow through with set production.

The argument that making all TVs so that they could receive and process digital and analog signals would raise the costs of these sets substantially would not be true in the case where all TV sets had to have the capability. The engineering and design costs needed to make such a conversion would not be high on a per-TV-set basis if all TV sets had to have this capability.

Nevertheless, without an all-channel requirement, given the highly price sensitive competitive nature of selling the high-volume TV set models, it is less likely that any manufacturer of such sets would take the risk of adding digital reception capability to mass market sets even if the resulting cost per set were low. Even a minimally higher price could be seen as placing the manufacturer at a competitive disadvantage in the mass market. If such a capability were offered only on upper-end sets, the per-TV set cost of offering the capability just on this small subset would be quite high making it unlikely that the price-sensitive customer would purchase such sets.

However, if DTV reception had to be available in all sets, the manufacturers' efforts would be focused on making this capability as low-cost as possible. Further, the costs would be spread over a very large number of manufactured units making the average cost small. New TV sales each year amount to about 25 percent of TV households.³ If it were mandated, the manufacturers' efforts would shift to making the capability as inexpensive as possible. There are numerous examples of how offering a feature on all models dramatically reduces the cost of such features and, when a feature becomes standard, that the manufacturers quickly move to reduce costs.

Finally, the high annual sales rate relative to the installed base of TV sets (about 25 percent of households per year) suggests that a large percentage of TV homes would be likely to have at least one digital-capable TV set within four years. This would provide a very strong incentive for networks to provide digital programming.

³ Approximately 25 million sets sold annually into an embedded base of approximately 100 million U.S. households.

2. **Requiring Cable Systems to Carry Both Analog and Digital Off-the-Air Signals**

The requirement that all cable TV systems must carry both digital and analog off-the-air signals should be implemented no sooner than the date when all new TV sets sold must be able to receive both a digital and analog signal. The implementation might be delayed somewhat because there will be only a small number of TV sets in the base for the first six months to a year after the requirement that all new TV sets sold must be digital-capable. It is important to require cable systems to carry both the analog and digital off-the-air signals for at least three years. After that, market forces should be relied upon.

At the outset, market forces are not likely to be sufficient. These cable systems would be under some competitive pressure from off-the-air digital signals and possibly from satellite providers (e.g., Direct TV) to carry the digital signals, but these providers also may not provide digital “local into local” broadcast programming, limiting the cable operators’ competitive incentives to do so.

Again, however, *the market pull for digital carriage needs an initial regulatory catalyst*. If the cable systems do not carry both digital and analog off-the-air signals, then any digital programming generated by the off-the-air stations will not reach the TV sets in cable homes.⁴ Given that 65% of all U.S. homes are cable TV homes, it would appear essential that cable systems carry the digital signals generated by the off-the-air station to make digital broadcasting valuable for broadcasters.

Cable systems probably will claim that it is not feasible to carry both the analog and digital signals due to channel availability limitations and/or that adding the digital signals is prohibitively expensive. However, digital compression will allow multiple DTV channels to be carried within a 6 MHz cable channel. It may be necessary for cable systems to use a converter box to allow the digital signal to be delivered in a form that the digital-ready TV set can process. Such boxes should be ready by the time the must-carry requirement kicks in, or such capabilities could be installed in sets meeting the FCC’s “digital cable-ready” specification.

The FCC has asked whether the dual-carriage burden could be reduced by making the dual carriage limitation of limited duration. I believe it would be necessary to mandate only that cable systems carry both analog and digital signals for three years after the date when new TV sets sold are to be capable of receiving both a digital and analog signal. At the end of this period, the majority of primary TV sets hooked into cable systems should be digital-capable. Given this situation, market forces would keep the cable system from removing the superior digital signal.

⁴ Often, there are TV sets in cable homes that are not hooked into the cable (i.e., get an off-the-air signal). However, the prime-time viewing is most often done in front of the TV sets hooked into the cable system.

DTV TRANSITION SCENARIOS

- **RAPID**
- **MODERATE**
- **SLOW**

BROADCAST DTV ROLLOUT SCENARIOS

	Rapid Transition	Moderate Transition	Slow Transition
LEGISLATION & REGULATION*	<ol style="list-style-type: none"> 1. The FCC Chairman adopts DTV as a critical issue for the FCC. 2. Proactive FCC mandates all channel receivers as of date certain (e.g., Jan 1, 2004) for sets 13" and larger. 3. FCC resolves all set top box technical issues, including copy protection. 4. FCC reaffirms the 2002 free-to-air DTV rollout requirement for commercial broadcasters but allows small markets (e.g., 101 and above) to opt to defer until no later than June 30, 2004. 	<ol style="list-style-type: none"> 1. The FCC remains a non-player until the next administration at which time the year 2005 Chairman of the FCC adopts DTV as one of his/her make or break issues. 2. FCC proceeds to rule on/close out open issues as per the rapid transition scenario only four years later and with free-to-air somewhat less significant. 3. On-air digital dates for broadcasters stretch out with waivers easy to obtain. 	<ol style="list-style-type: none"> 1. DTV not adopted by any administration or FCC Chairman as an issue upon which to spend political capital. 2. Congress holds occasional hearings but becomes irrelevant to DTV. 3. FCC adopts "let the market decide" approach on all key issues. 4. FCC remains reactive not proactive.

* See next section for a discussion of the must-carry issue.

BROADCAST DTV ROLLOUT SCENARIOS

	Rapid Transition	Moderate Transition	Slow Transition
DTV MUST-CARRY	<ol style="list-style-type: none"> 1. FCC resolves cable must-carry (e.g., cable must-carry free-to-air DTV signals up to capacity limits with station election of signal to be carried); program-related enhancements (including advertising and program interactivity) must be passed; HDTV signals must be passed without material alteration; reasonable fees imposed for retransmission of multiplexed programs for which broadcasters charge a subscription fee. 	<ol style="list-style-type: none"> 1. FCC delays initiation of must-carry resolution until 2005 (new administration); outcome similar to rapid transition but a half decade later. 	<ol style="list-style-type: none"> 1. No mandated free-to-air DTV carriage until analog shut off. 2. DTV carriage prior to analog shut off only pursuant to voluntary agreements.

BROADCAST DTV ROLLOUT SCENARIOS

	Rapid Transition	Moderate Transition	Slow Transition
CONSUMER ELECTRONICS & SET-TOP TECHNOLOGY	<ol style="list-style-type: none"> 1. CE industry reaffirms commitment to U.S. free-to-air DTV; R&D funds committed to improve digital reception; fourth generation chips in sets as of mid-2002. 2. Set prices decline as volume increases consistent with prior CE industry practice. 3. CE industry supports All-Channel Receiver Act as one price of moving DTV forward in the U.S. 4. Cable set top boxes available with DTV pass through capabilities. 5. Low-cost digital-to-analog converters available at retail stores in late 2004 for unwired sets. 6. DBS and broadcasters deploy joint antenna systems for free-to-air pick-up of digital signal. 	<ol style="list-style-type: none"> 1. CE industry puts free-to-air DTV on hold until market more promising; R&D diverted to satellite and cable. 2. Volume ramp up for mass market delayed; probably begins no sooner than 2006. 3. Same as rapid transition scenario except four to six years later. 	<ol style="list-style-type: none"> 1. CE industry assigns low priority to free-to-air DTV; focuses on cable and satellite markets; R&D funds diverted away from free-to-air improvements. 2. Because of low volume sales, prices decline slowly as sales of free-to-air receivers are minor compared to cable and satellite digital receivers. 3. CE industry gradually and voluntarily installs all channel receivers so that analog-only new sales no longer occur after 2010. 4. Cable operators never make available converter boxes for DTV pass through until analog turn off. 5. Limited retail availability of digital-to-analog converters.

BROADCAST DTV ROLLOUT SCENARIOS

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	Rapid Transition	Moderate Transition	Slow Transition
PROGRAMMING/CONTENT	<ol style="list-style-type: none"> 1. Networks make available significant HDTV programming, particularly sports and movies, as well as other enhanced programming. 2. Local broadcasters use multiplex capabilities to transmit local content (e.g., news and high school sports with channel choice by county). 3. Consumers increase demand for DTV; market pull <i>begins</i> to replace supply push circa 2004-05. 4. Broadcasters sell advertisers on DTV's enhanced capabilities (e.g., interactive advertising and very attractive demographics); advertising revenues increase. 	<ol style="list-style-type: none"> 1. Networks delay content; delay rolls through production supply chain delaying digitalization of content. 2. Local broadcasters stretch out multi-casting trials because: (a) lack of must-carry rules frustrate business case; and (b) free-to-air DTV receivers remain scarce. 3. Advertisers focus on cable networks with return channel for interactive advertising. 4. Over-the-air content not in significant in quantity until 2003-04 season. 	<ol style="list-style-type: none"> 1. Networks hold production costs down; limited availability of HDTV and enhanced programming until after 2005-06 season. 2. Broadcasters make limited use of multiplex capabilities (e.g., due to lack of cable carriage and/or production costs). 3. Consumers indifferent to free-to-air DTV for most of first decade of 21st century. 4. Lack of consumer interest dooms advertiser interest.

BROADCAST DTV ROLLOUT SCENARIOS

	Rapid Transition	Moderate Transition	Slow Transition
SPECTRUM AUCTIONS*	<ol style="list-style-type: none"> 1. Congress recognizes difficulty of shutting off analog in 2006 but makes it a policy priority to achieve turn off no later than Dec. 31, 2010; FCC instructed to facilitate. 2. Government continues pressure for auctions; channel 60-69 auctions occur in late 2001 or early 2002; broadcasters relocated prior to analog switch off in their DMA with incentives paid by auction winners. 3. Channel 52-59 auctioned in 2005 (three years late); relocation process similar to channel 60-69. 	<ol style="list-style-type: none"> 1. Channel 60-69 auctions occur in March 2002 but auction fervor subsides due to no realistic analog shut off plan; government frustrated at inability to generate auction revenues. 2. Channel 52-59 auctions deferred indefinitely. 3. Broadcasters retain dual channels with digital channel largely underutilized; Government displeased. 4. Government imposes escalating spectrum use taxes. 	<ol style="list-style-type: none"> 1. Channel 60-69 auctions deferred until 2003; bid revenue fails materially to meet CBO projections because bidders doubt spectrum will be vacated within business relevant timeframe. 2. Government suspends further spectrum auctions, resolves to offset auction revenue foregone with spectrum use taxes; such taxes based on hypothetical highest and best use (not actual use). 3. Industries that could use spectrum accommodated elsewhere and/or forced to adjust. 4. Situation persists until end of second decade (circa 2020).

* Spectrum auctions are relevant to DTV rollout because government agencies desirous of maximizing auction revenue have an incentive to take actions that support broadcasters vacating rapidly the auctioned or to-be-auctioned spectrum. Conversely, the government has an incentive to punish (i.e., tax) broadcasters if the perception is that the broadcast industry is delaying the auction process.

BIOGRAPHY OF
DR. JOSEPH S. KRAEMER

Dr. Joseph S. Kraemer holds the title of Director at LECG, LLC, a consulting firm with expertise in capital intensive industries undergoing structural change. He is an experienced management consultant who works across multiple industries, geographies, and client situations. He has assisted numerous companies to develop and implement market entry strategies.

Dr. Kraemer has worked with, and served as counselor to, senior management at communications and high tech companies in Asia, Europe, and the Americas. He speaks regularly at conferences around the world and has been an expert witness before regulatory and legislative forums. Dr. Kraemer has participated as a facilitator and commentator at management sessions focused upon the impacts of competition, strategies for revenue growth, and requirements for rapid organizational change. He is quoted frequently in major publications and the trade press.

Dr. Kraemer has been consulting on digital television issues since 1996. He recently completed an analysis for the NAB that addressed the business implications of the modulation selection decision process. He also co-authored *Digital Television in a Digital Economy: Opportunities for Broadcasters*, a study of strategy issues. Recent presentations by him include: “Telephony, Television, & the Internet: Convergence Trends and Realities” and “Digital Television in the United States: Long Fuse & Big Bang.”

Dr. Kraemer serves on the faculties of both the Georgetown University McDonough School of Business and the Kogod Business School of American University where he specializes in e-commerce strategy courses. He is on several boards, including Exigent (NASDAQ) and the Center for Telecommunications Management (University of Southern California). The Progress & Freedom Foundation (Washington, D.C.) has designated Dr. Kraemer a Senior Fellow. He operates from an office in Washington, DC and resides with his family in Northern Virginia.